

Lessons Learned: Acute Mercury Poisoning From A Residential Work/Hobby Exposure In Iowa, 2014

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Background

- In the United States, mercury poisoning typically occurs from
 - ingestion of contaminated fish or
 - from inhalation or absorption through skin because of an occupational exposure.

Background

- No national numbers on mercury poisoning are available as it is not a nationally reportable disease
- During 2012, a total of 3,422 calls were made to U.S. poison control centers regarding mercury exposures, and 556 potential exposures were treated at health care facilities

Iowa Mercury Cases

| Year | Number of Cases Reported |
|-------|--------------------------|
| 2010 | 1 |
| 2011 | 8** |
| 2012 | 2 |
| 2013 | 0 |
| 2014* | 2* |

***as of 10/6/14**

****includes 3 cases linked to contaminated Ayurvedic products from India**

Mercury Exposure Factors

Severity of health effects are dependent on:

- the chemical form of mercury
- the dose
- the age of the person exposed (the fetus is the most susceptible)
- the duration of exposure
- the route of exposure -- inhalation, ingestion, dermal contact, etc.
- the health of the person exposed

From www.epa.gov/mercury/effects.htm

Background

Mercury exists in various chemical forms.

Each have specific effects on human health.

- **Inorganic or Elemental Mercury:** includes metallic mercury and mercury vapor (Hg^0) and mercurous (Hg_2^{++}) or mercuric (Hg^{++}) salts
 - Inhaled elemental mercury vapor is easily absorbed through mucus membranes and the lung, deposits elemental mercury in the brain, and rapidly oxidized to other forms.
- **Organic Mercury:** includes compounds in which mercury is bonded to a structure containing carbon atoms (methyl, ethyl, phenyl, or similar groups)
 - Methylmercury is easily absorbed through the gut and deposits in many tissues, but does not cross the blood-brain barrier as efficiently as elemental mercury.
- **Mercury salts** tend to be insoluble, relatively stable, and poorly absorbed.

Methylmercury Exposure

- Primary Exposure concern: ingestion
 - example: eating contaminated fish or seafood
- For fetuses, infants, and children, the primary health effect of methylmercury is impaired neurological development.
 - impacts on cognitive thinking, memory, attention, language, and fine motor and visual spatial skills have been seen in children exposed to methylmercury in the womb, even when mother was asymptomatic
- Other symptoms of methylmercury poisoning may include;
 - impairment of the peripheral vision
 - disturbances in sensations ("pins and needles" feelings, usually in the hands, feet, and around the mouth)
 - lack of coordination of movements
 - impairment of speech, hearing, walking; and muscle weakness

From www.epa.gov/mercury/effects.htm

Elemental Mercury Exposure

- Primary exposure concern: when breathed as a vapor and absorbed through the lungs
- Exposures can occur when elemental mercury is spilled or products that contain elemental mercury break and expose mercury to the air, particularly in warm or poorly-ventilated indoor spaces.
- Symptoms include:
 - Tremors
 - emotional changes (mood swings, irritability, nervousness, excessive shyness)
 - Insomnia
 - neuromuscular changes (weakness, muscle atrophy, twitching)
 - Headaches
 - disturbances in sensations
 - changes in nerve responses
 - performance deficits on tests of cognitive function
- Higher exposures may cause kidney effects, respiratory failure and death

Other Mercury Compounds (inorganic and organic)

- Inorganic and organic mercury compounds are absorbed through the gastrointestinal tract and affect other systems via this route.
 - Organic mercury compounds are more readily absorbed via ingestion than inorganic mercury compounds.
- High exposures to inorganic mercury may result in damage to the gastrointestinal tract, the nervous system, and the kidneys.
- Symptoms of high exposures to inorganic mercury include:
 - skin rashes and dermatitis
 - mood swings
 - memory loss
 - mental disturbances
 - muscle weakness.

Occupational Mercury Exposure

Mercury has many uses. Occupational exposure can occur during manufacturing, repair, or recycling, including these types of products:

- industrial and medical devices
- inorganic and organic compounds for use as pesticides, antiseptics, germicides, and skin preparations
- amalgams for use in tooth restorations
- chemical processing, molding operations
- fluorescent lights and compact fluorescent light bulbs
- electronic and thermostatic switches

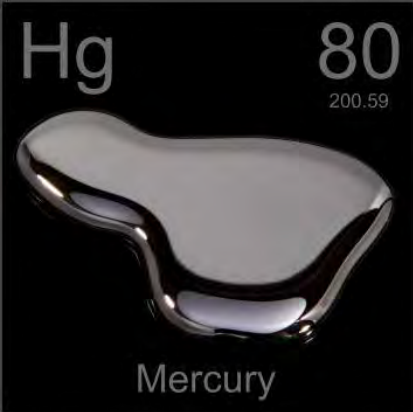


The Mad Hatter

- Hat-makers in the 17th century commonly exhibited slurred speech, tremors, irritability, shyness, depression, and other neurological symptoms
- Symptoms were associated with chronic occupational exposure to mercury in poorly ventilated rooms, using hot solutions of mercuric nitrate to shape wool felt hats



©Disney Promotional Photo



Mercury Surveillance

- The current Iowa Code requires reporting weekly of blood mercury results that are 2.8 micrograms per deciliter or higher to the environmental health program at IDPH.
- Both medical providers and laboratories have an obligation to report.
- Currently, results can be:
 - Entered into IDSS through ELR – electronic laboratory reporting, with alerts generated to notify IDPH staff of new cases
 - Manually entered into the IDSS database (IDPH EHS staff or local medical/public health people with IDSS access).
 - Called, faxed, or electronic reporting by lab or medical provider

Case Timeline, Spring 2014:



- **Day 1:** Middle-aged male patient admitted to hospital with known chemical exposure, respiratory distress
- **Day 7:** Patient had heavy metal blood test panel drawn, ordered by attending medical provider
- **Day 11:** Abnormal mercury result was reported by reference laboratory that performed the test to the patient's hospital lab, which had submitted the specimen for testing



12 days: test draw date

8 days: test result known by Dr.



- **Day 18** from admission: A paper copy of the blood mercury test result was received in the mail by IDPH CADE (infectious disease) from the testing laboratory.
- Report forwarded to IDPH Environmental Health Services lead data intake person.
 - No patient address or phone information included on the paper copy report from testing lab. Address/phone information obtained through phone call to hospital by IDPH EHS data staff.
- Report forwarded to IDPH Occupational Health & Safety Surveillance Program (OHSSP) for follow-up and input into IDPH surveillance system (IDSS).
 - No medical provider information (other than hospital laboratory name and number) provided on laboratory report.

14 days: test draw date

10 days: test result known by Dr.

3 days: test reported to IDPH



- **Day 20** from admission: Blood mercury test report reviewed by IDPH OHSSP and noted to be elevated at 86 mcg/L (8.6 mcg/dL).
- IDPH OHSSP contacted hospital lab, clinic, medical records at hospital, and attending physician seeking primary medical provider and information regarding possible exposure source.
 - Message left and follow-up form faxed to attending physician (hospitalist) at hospital office.



Urgency Assessment

- Patient was known to be hospitalized in intensive care
- Contact using patient phone number provided was not attempted because patient hospitalized, lived alone

20 days: test draw date

17 days: test result known by Dr.

10 days: test reported to IDPH



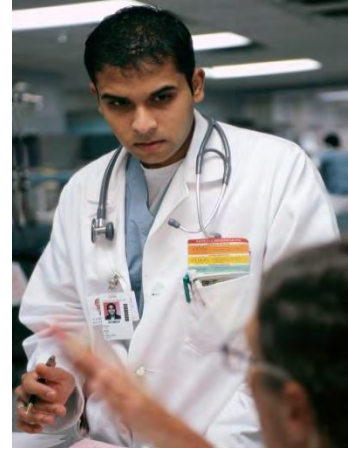
- **Day 27** from admission: No response from attending physician regarding message and fax on Day 20.
 - Case referred to IDPH Epidemic Intelligence Service (EIS) officer for help with follow-up to contact attending physician for information about the source of the exposure.
- Multiple attempts made Days 27-32 without response from attending physician



26 days: test draw date

22 days: test result known by Dr.

15 days: test reported to IDPH

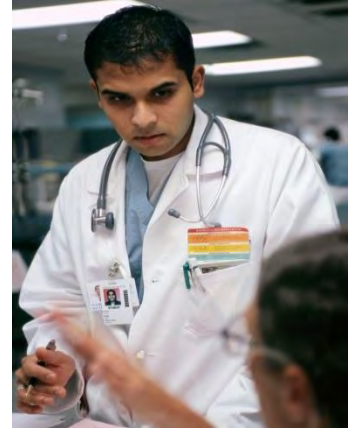


- **Day 32** from admission: Attending physician responded to IDPH regarding source of exposure.
 - EIS officer interviewed attending physician, who gave basic details of exposure, status:
 - Patient had reported smelting old computers at home to recover gold and silver
 - Patient was in the ICU on ventilator for about 2 weeks.
 - Chief concern: acute respiratory failure from chemical pneumonitis leading to ARDS – Acute Respiratory Distress Syndrome
 - FYI: Occupational chemical pneumonitis is also reportable

26 days: test draw date

22 days: test result known by Dr.

15 days: test reported to IDPH



- **Day 32:** Attending physician – continued:
 - The attending physician did not feel there was a sense of urgency regarding the mercury exposure because his primary concern was the chemical pneumonitis the patient had experienced, which he did not feel was related to the co-existing mercury exposure.
 - Reported that no treatment specific to the mercury exposure was given, and no repeat blood test was done.
 - Patient had been recently discharged to long-term care facility on oxygen until able to resume living independently.
- EIS Officer requested medical chart for review.

26 days: test draw date

22 days: test result known by Dr.

15 days: test reported to IDPH



- **Day 32:** IDPH OHSSP called the following state and local contacts:
 - DNR Hg Spill Hotline – since not a known Hg spill, referred IDPH to DNR environmental field office regarding air monitoring resources
 - DNR environmental field office – since not a known Hg spill, felt they could not call in HazMat, referred IDPH to County Environmental Health
 - Field office contacted the local wastewater facility
 - County Environmental Health - no equipment for air monitoring for mercury
 - Patient, who was now in nursing home, provided additional details regarding the activities that caused his exposure.

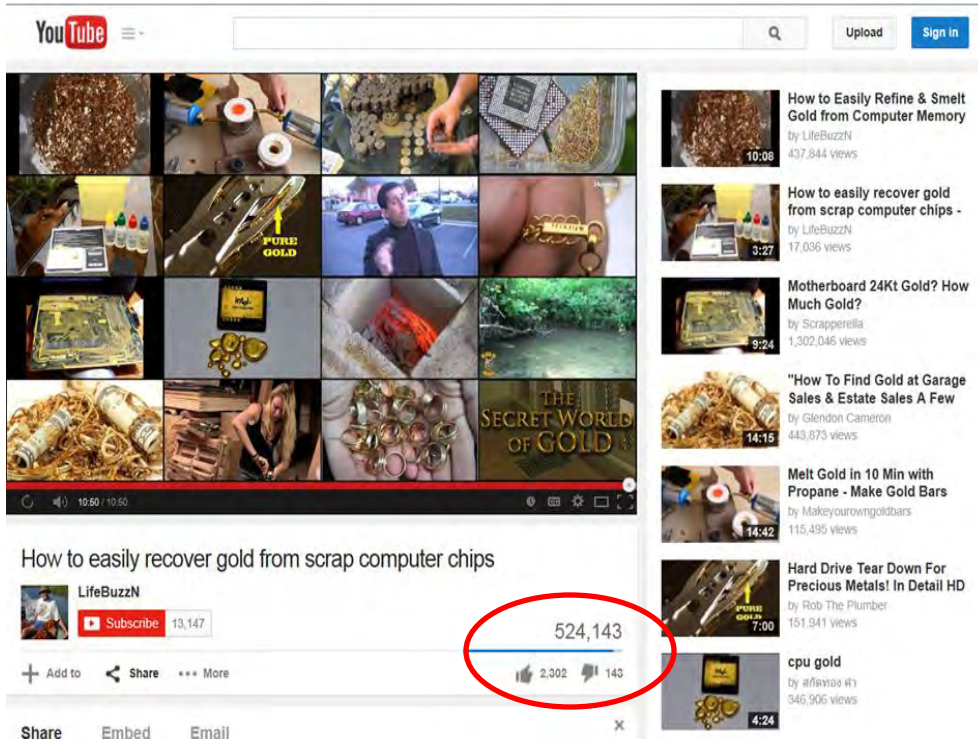


Exposure History per Patient Phone Interview

Day 32 from Hospital Admit

- Patient reported smelting of old computer chips in order to recover gold and silver. Had been doing for about a month prior to getting sick; recovered 1 oz. gold, 6 oz. silver in 1 month. Project done by him and adult son.
- Chemical Smelting in Patient's kitchen, using:
 - Urea (carbamide) - $\text{CH}_4\text{N}_2\text{O}$
 - Sodium metabisulfite - $\text{Na}_2\text{S}_2\text{O}_5$
 - Hydrogen peroxide - H_2O_2
 - Muriatic acid (hydrochloric acid) - HCl
 - Nitric Acid - HNO_3
 - Sulfuric Acid - H_2SO_4
- Bought chemicals locally and online
- Learned the technique from YouTube®

YouTube[©] Options Galore



YouTube

How to easily recover gold from scrap computer chips

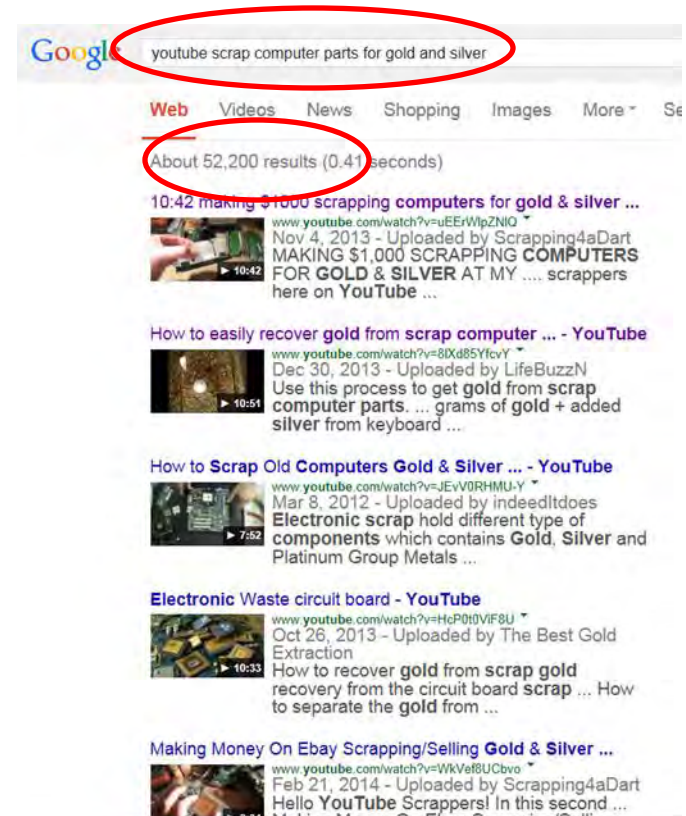
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About 52,200 results (0.41 seconds)

10:42 making \$1000 scrapping computers for gold & silver ...

How to easily recover gold from scrap computer ... - YouTube

How to Scarp Old Computers Gold & Silver ... - YouTube

Electronic Waste circuit board - YouTube

Making Money On Ebay Scrapping/Selling Gold & Silver ...

Examples of Google Search

**"In this video I'm recovering gold from computer Memory Chips (RAM). Use this process to get gold from scrap computer parts.
DO NOT DO THIS AT HOME."**

screen shots from online video



Exposure History – Patient Phone Interview, Day 32

- Used surplus military gas mask with filter cartridges
 - Felt burning in nose and throat, changed filter, kept going
 - Son was not present that day
- Developed shortness of breath, tremors, and weakness
- Sought medical care after about two days
- 2nd Method tried at some time in month prior to hospitalization
 - Ordered ½ pound of mercury online
 - Reported using ~ 2 ounces
 - Used frying pan to smelt the computer chips along with mercury, possibly nitric acid or other chemicals; believe heat applied to volatilize the mercury
 - Idea from watching History[®] channel story about Columbians using mercury to recover gold from soil

Current Site Situation Status

as of Day 32 Phone Interview (Wednesday)



- Patient still in care facility on oxygen
- Lived alone in home
- Adult son had already removed remaining chemicals from home
- Family was planning to “throw out” all his furniture that weekend
- Family planned to hire a home cleaning company to come in and clean carpets



Concerns - Questions

- Who else was present or had spent time in the home since they had been doing this? Was anyone else tested for mercury exposure?
- How much mercury was vaporized? What were the mercury levels in the home?
- Other hazards from chemicals in home?
- Did the furniture and household belongings need to be dumped? If so, precautions to take? Cleaning needed in home?
- What happened to chemicals after use? Where or how disposed?
- What happened to the residual sludge, filters, computer parts after use? Where or how disposed?
- What had happened to the chemicals that were removed from the home?
- How dangerous was it for anyone to go into the home?
- Who can respond to do testing, risk assessment, clean-up?

26 days: test draw date

22 days: test result known by Dr.

15 days: test reported to IDPH



- **Day 32:** Meeting held at IDPH with teleconference to County Environmental Health to discuss next steps



33 days: sought medical care
27 days: test draw date
23 days: test result reported Dr.
16 days: test reported to IDPH



- **Day 33** from admission: Local Fire Department was contacted by County Environmental Health
 - House was posted by County
 - Local FD activated HazMat team to assess potential hazard at home
 - Local FD met with patient to discuss situation
 - HazMat Team subsequently mitigated the hazard at the home

Public Health Event of Concern

On the 33rd day from the date the patient accessed medical care and was hospitalized in respiratory distress, the air in the home was tested by the local HazMat Response Team. Kitchen air mercury level was still $0.8\mu\text{g}/\text{m}^3$ (reference concentration $<0.3\mu\text{g}/\text{m}^3$)

Unsure of date(s) when mercury process was used by patient, but residual air mercury levels in home were approximately 1-2 months after mercury was used (volatilized) in home during smelting process.

Public Health Action

- Remediation was performed
 - using chemical wipes on kitchen surfaces
 - heating the home to over 80°F for more than an hour
 - ventilating the home with a negative pressure fan
- Air monitoring conducted numerous times over one and a half day
- All contaminated materials were removed and disposed of according to EPA recommended guidelines
- After each ventilation air mercury measurements were taken until the levels were reduced to within acceptable range

Challenges Faced

- Incomplete information received from laboratory for patient and medical provider
- Difficulty contacting the healthcare provider for additional information and non-compliance with state mandatory reporting rules
- Patient was in ICU for about two weeks and was not able to talk, no other household/family contact information provided
- Unclear capacity for various local and state agency response (environmental testing, clean-up) and jurisdictional responsibilities for this type of situation

Event Problem Summary

- This case had a blood mercury test result of 86 micrograms per liter, or 8.6 micrograms per deciliter (reportable at 2.8 mcg/dL).
- While the test report was received by IDPH a week after it was reported to the hospital/medical provider, there was a further delay in the site environmental response because IDPH personnel waited for a reply from the attending physician for information regarding the source of the patient's exposure.
- Local jurisdiction contacts were not notified to assist with intervention/remediation until:
 - 32 days from when patient accessed medical care
 - 26 days from when the blood test was drawn
 - 22 days from when the results were known by the attending physician/laboratory
 - 15 days from when the results were known by IDPH
 - Same day, with action taken when source of exposure was determined by IDPH

Post Event Review –Lessons Learned

- Discussions were held with local public health professionals to discuss at what point in an investigation the state should contact the local jurisdiction environmental health response team (EHRT) regarding human elevated mercury test results.
- The conclusion was a decision to notify the EHRT team with jurisdiction as soon as the state is aware of an elevated mercury test result. Follow-up will then be determined on a case-by-case basis.



Post Event Review – Revised Protocols

- IDPH will periodically disseminate reminders to healthcare providers that mercury poisoning or a high mercury level in blood is a reportable condition in Iowa and subject to immediate reporting.
- Follow-up protocols were changed to promote rapid identification of exposure source information regardless of the response time from key contacts, such as medical providers.
 - IDPH EHS personnel will request medical records and/or work with local public health EHRT contacts to gain access to information in a timely manner.



Thank You

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